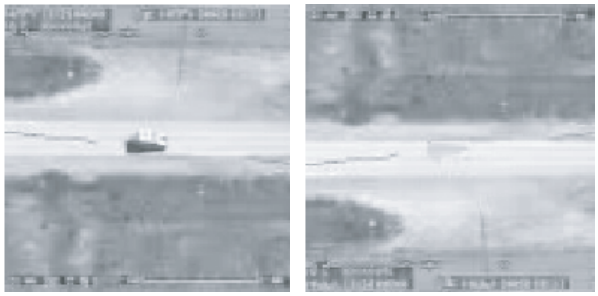
Human Factors

research and technology division

The Spatial Standard Observer: A Tool to Measure Visibility in Tasks, Displays, and Interfaces

Objective

Design of complex aerospace vehicles and systems, especially their visual interfaces and visual instruments, frequently requires estimates of the visibility and discriminability of visual elements. Likewise task design frequently requires an understanding of whether something can be seen, or whether two things can be visually distinguished. There is a need for a general purpose tool, akin to a photometer, for easily measuring visibility.



(A) (B)

Figure 1. Example of use of SSO to calculate visibility of targets viewed from an Unpiloted Aerial Vehicle (UAV). A. Image containing target, calculated to have a visibility of 4.25 JND. B. Image with target that has been reduced in contrast to have a visibility of 1 JND.

Approach

The Spatial Standard Observer (SSO) provides a tool that allows measurement of the visibility of an element, or visual discriminability of two elements. The device may be used whenever it is necessary to measure or specify visibility or visual intensity.

The SSO is based on a model of human vision, and has been calibrated by an extensive set of human test data. The SSO operates on a digital image or a pair of digital images. It computes a numerical measure of the perceptual strength of the single image, or of the visible difference between the two images. The visibility measurements are provided in units of Just Noticeable Differences (JND), a standard measure of perceptual intensity. A target that is just visible has a measure of 1 JND.

Impact

The SSO will be useful in a wide variety of applications, such as evaluating vision from unpiloted aerial vehicles (UAV) (Figure 1), predicting visibility of UAVs from other aircraft, estimating visibility from the control tower of aircraft on runways, measuring visibility of damage to aircraft and to the shuttle orbiter, evaluation of legibility of text, icons or symbols in a graphical user interface, specification of camera and display resolution, inspection of displays during the manufacturing process, estimation of the quality of compressed digital video, and predicting outcomes of corrective laser eye surgery. NASA has applied for a patent on SSO technology.

The SSO is an example of Human Technology — engineering tools and technology based on a deep understanding of human motor, cognitive, and perceptual capabilities. NASA Ames researchers are world leaders in computational modeling of human perception and cognition, and are using that expertise to develop suites of engineering design tools based upon these models.

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URL: http://vision.arc.nasa.gov/sso/